Report on the International Linear Collider Project[1]

Science Council of Japan

Executive Summary

1. Background

The International Linear Collider (ILC) is a large planned research facility that aims to unveil the mystery of the origin of the universe, as well as time, space, and mass, by producing a high energy reaction in which the energy is nearly as high as in the beginning of the universe. It is a linear accelerator of a total length of about 30 km, to reach the highest energy that is attainable in electron-positron colliding beam machines to date. In order to promote the ILC project, the International Linear Collider Steering Committee (ILCSC) was set up under the auspices of the International Committee for Future Accelerators (ICFA). An international team comprising high-energy physics researchers from three continents (namely Asia, Europe, and North America) conducted the detailed studies and released a technical design report on June 12, 2013.

In Japan, in addition to the preparatory work by the high-energy particle physics community, there is also a campaign to invite the ILC to Japan in political and business sectors both nation-wide and locally in the areas of the construction candidate sites. Science Council of Japan (SCJ) received a letter of request for deliberation of the ILC project from an academic point of view from the Research Promotion Bureau of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan on May 27, 2013 and set up the Issue-Oriented Committee for the International Linear Collider Project (hereinafter referred to as "the Committee") for intensive deliberation.

2. Deliberation Process

The letter of request from MEXT outlined the four items to be discussed as follows:

- ○ The scientific significance of the research at the ILC and the ILC's specific role in particle physics;
- ○ The impact of the ILC project on the broader academic community;
- ○ The impact of hosting the ILC in Japan on its society;
- ○ The current status of the preparatory work and necessary conditions for the implementation of the ILC project including securing financial and human resources required for its construction and operation.

[1] This document is an English translation of the Japanese original, made for reference purpose.

The Committee considered these items and additional matters. The Committee held hearings with experts in high-energy particle physics, including researchers who promote the ILC project, and a project management expert from ITER (International Thermonuclear Experimental Reactor), a precedent large international collaborative project in the field of nuclear fusion research.

3. Recommendations

The Committee has summarized the issues regarding the significance of the ILC project and Japan's bid to host it from two viewpoints. Namely, (1) to identify the need for and significance of an electron-positron collider and the significance of the ILC as a next generation electron-positron collider, and (2) a deliberation of the outstanding issues involved to make a decision of hosting it in Japan.

(1) The need for and significance of an electron-positron collider and the ILC as a next generation electron-positron collider:

High-energy particle physics that the ILC would explore is the most fundamental field in basic science. It embodies exploration of the knowledge frontier aiming at fundamental understanding of the nature. Given the fact that the future strategies for the Large Hadron Collider (LHC), the current highest energy proton-proton colliding machine, have been announced by CERN including its upgrade path, the Committee appreciates the need for and scientific significance of an electron-positron collider as a unique complement to the proton-proton collider. The Committee finds that the ILC is the most natural next machine for electron-positron colliders and that the Technical Design Report (TDR) published in June 2012 is based on the intensive and detailed study conducted by an *international* team of scientists. The Committee appreciates that the ILC enables the precision measurements of the detailed properties of the Higgs particle and the top quark, thereby exploring the physics beyond the Standard Model of particle physics and, therefore, it acknowledges that the ILC is endowed with the scientific value in particle physics. The Committee, however, expresses the desire for more compelling and articulate argument to justify the ILC project in order to search for unknown particles and the physics beyond the Standard Model, running concurrently with the upgraded LHC, given the considerable investment it will require.

(2) Issues to be clarified for a decision to host the ILC in Japan.

In view of the required large financial and human resources, it is clear that the ILC

project cannot be implemented by a single country or region; the implementation requires a continuous commitment from the participating countries and regions. As regards invitation of the ILC to Japan, the Committee finds that there is some uncertainty and risk in critical issues, such as readiness of potential host organization, the expected participation of researchers from abroad, and prospect for international sharing of the financial burdens.

The Committee recognizes that Japan currently faces many outstanding social issues, such as the recovery from the 2011 Great East Japan Earthquake and the challenges regarding energy, natural resources, and the environment in the future. In order to host the ILC in Japan, it is necessary for governmental and academic stakeholders jointly to demonstrate a sustainable framework that bears the very large, long-term financial burden in the time of the national finance straits. This framework needs also to be supported by the public. The allocation of resources to the ILC should not have adverse consequence on other areas of national importance, including other academic fields that help build nation that is creative in science and technology. The Committee, thus, concludes it is too early to grant the full-scale implementation of the ILC project in Japan at the moment.

The Committee suggests that the government of Japan should (1) secure the budget required for the investigation of various issues to determine the possibility of hosting the ILC, and (2) conduct intensive studies and discussions among stakeholders, including authorities from outside high-energy physics as well as the government bodies involved for the next two to three years. Before making the final decision of whether the ILC should be hosted in Japan, the issues and concerns described in this document should be fully investigated and a clear vision for solutions needs to be provided. They include the whole profile of project cost for the construction, operation, upgrades and decommissioning, as well as prospect for cost-sharing among the countries involved. Also included are the issues related to human resources and management/operation organization.

In parallel, it is necessary to have discussions with the research institutes and the responsible funding authorities of key countries and regions involved outside of Japan, and to obtain clear understanding of the expected sharing of the financial burden. All of the conditions for the implementation of the ILC project in Japan and achieving a high performance need to be elucidated. Must also be obtained a consensus regarding the

project both in the broad academic community and the public at large.

The Committee lists issues to be addressed as follows:

- A more precise research strategy for the ILC in view of the LHC upgrade path;
- The funding framework that does not affect the broader field of science or other critical national priorities;
- Detailed plan of international cost-sharing;
- A domestic organization to implement the project consisting of the High Energy Accelerator Research Organization (KEK) and universities;
- Human resources required during construction and operation, in particular, for leadership positions.

The Committee reiterates that a clear vision of the above critical issues must be provided in order to justify hosting the ILC in Japan.

Upon completion of the above investigations, SCJ is prepared to contribute to the government's decision by presenting scientific and academic perspectives.